REMARKS

Claims 1, 11, 17, 29, 35, 41, 55, 58, 65 and 79 are amended. Claims 1-89 are in the application.

The title and certain independent claims are amended to remove reference to volatility and recite that the subject devices chalcogenide comprising, as is clearly supported in the specification as filed.

Examination on the merits is requested.

Respectfully submitted,

Dated: 8-21-02

By: _____
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. 09/943,199
Filing Date . . . . . August 29, 2001
Inventor . . . . . Kristy A. Campbell
Assignee . . . . . Micron Technology, Inc.
Group Art Unit 2818
Examiner . . . . . Unassigned
Attorney's Docket No. MI22-1672
Title: Method of Forming Chalcogenide Comprising Devices (as amended)

VERSION WITH MARKINGS TO SHOW CHANGES MADE ACCOMPANYING PRELIMINARY AMENDMENT SUBSEQUENT TO DECEMBER 8, 2000 FILING DATE

In the Title:

The title has been amended as follows. Underlines indicate insertions and ~~strikeouts~~ indicate deletions.

Method Of Forming ~~Non-Volatile Resistance Variable~~ Chalcogenide Comprising Devices

In the Claims

The claims have been amended as follows. Underlines indicate insertions and ~~strikeouts~~ indicate deletions.

1. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a metal doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising the metal and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table;

forming a passivating material over the metal doped chalcogenide comprising material; and

depositing a second conductive electrode material over the passivating material, and forming the second conductive electrode material into an electrode of the device.

11. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a metal doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising the metal and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table, the metal doped chalcogenide electrode material having an outer surface;

exposing the outer surface to an atmosphere having a temperature elevated from ambient room temperature for a period of time effective to form a passivating material on the metal doped chalcogenide comprising material outer surface; and

depositing a second conductive electrode material over the passivating material, and forming the second conductive electrode material into an electrode of the device.

17. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a metal doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising the metal and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table, the metal doped chalcogenide electrode material having an outer surface;

exposing the outer surface to ambient room temperature and pressure for a period of time effective to form a passivating material on the metal doped chalcogenide comprising material outer surface; and

depositing a second conductive electrode material over the passivating material, and forming the second conductive electrode material into an electrode of the device.

29. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a metal doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising the metal and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected

from Group 13, Group 14, Group 15, or Group 17 of the periodic table, the metal doped chalcogenide electrode material having an outer surface;

exposing the outer surface to a plasma comprising at least one of oxygen or hydrogen effective to form a passivating material on the metal doped chalcogenide comprising material outer surface; and

depositing a second conductive electrode material over the passivating material, and forming the second conductive electrode material into an electrode of the device.

35. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a metal doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising the metal and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table, the metal doped chalcogenide electrode material having an outer surface;

exposing the outer surface to an aqueous solution effective to form a passivating material on the metal doped chalcogenide comprising material outer surface; and

depositing a second conductive electrode material over the passivating material, and forming the second conductive electrode material into an electrode of the device.

41. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a metal doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising the metal and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table, the metal doped chalcogenide electrode material having an outer surface;

oxidizing the metal doped chalcogenide electrode material outer surface effective to form a layer comprising at least one of an oxide of "A" or an oxide of "B"; and

after the oxidizing, depositing a second conductive electrode material over the layer comprising at least one of the oxide of "A" or the oxide of "B", and forming the second conductive electrode material into an electrode of the device.

55. (Amended) The method of claim 41 comprising forming the ~~non-volatile resistance variable~~ device into a programmable memory cell of memory circuitry.

58. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a metal doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising the metal and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table, the metal doped chalcogenide electrode material having an outer surface;

exposing the outer surface to an HNO_3 solution; and

after the exposing, depositing a second conductive electrode material over the chalcogenide comprising material, and forming the second conductive electrode material into an electrode of the device.

65. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming a silver doped chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising silver and A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table, the silver doped chalcogenide electrode material having an outer surface;

oxidizing the silver doped chalcogenide electrode material outer surface effective to form a dielectric layer comprising at least one of an oxide of "A" or an oxide of "B", the dielectric layer being no greater than 50 Angstroms thick; and

after the oxidizing, depositing a second conductive electrode material over the dielectric layer, and forming the second conductive electrode material into an electrode of the device.

79. (Amended) A method of forming a ~~non-volatile resistance variable~~ chalcogenide comprising device, comprising:

forming a first conductive electrode material on a substrate;

forming chalcogenide comprising material over the first conductive electrode material, the chalcogenide material comprising A_xB_y, where "B" is selected from the group consisting of S, Se and Te and mixtures thereof, and where "A" comprises at least one element which is selected from Group 13, Group 14, Group 15, or Group 17 of the periodic table;

forming a metal comprising layer over the chalcogenide comprising material;

irradiating the metal effective to break a chalcogenide bond of the chalcogenide material at an interface of the metal and chalcogenide material and diffuse at least some of the metal into the chalcogenide comprising material, and forming an outer surface of the chalcogenide comprising material;

after the irradiating, oxidizing the metal doped chalcogenide electrode material outer surface effective to form a dielectric layer comprising at least one of an oxide of "A" or an oxide of "B", the dielectric layer being no greater than 50 Angstroms thick; and

after the oxidizing, depositing a second conductive electrode material over the chalcogenide comprising material, and which is continuous and completely covering at least over the chalcogenide comprising material, and forming the second conductive electrode material into an electrode of the device.

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